

Taxonomic Revisions in the family Haloragaceae

II. Further notes on *Haloragis*, *Haloragodendron* and *Gonocarpus*

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Abstract

Additional notes are provided on new records and re-collections of seven species of *Haloragis*, one species of *Haloragodendron* and fifteen species of *Gonocarpus*, mainly from Western Australia. One new species, *Haloragis dura*, is described, and the division of *Gonocarpus* into two sections, sect. *Gonocarpus* and sect. *Simplum* is proposed. Three species previously known only from incomplete material are redescribed.

While a recently completed revision of *Haloragis* and related genera was in press (Orchard, 1975), a number of new records and re-collections of poorly known species became available. As withdrawal of the manuscript to incorporate these changes was not feasible, they are presented here as a supplement to that paper. To facilitate comparison, the same numbers have been given to the species as in the original work. Amended maps and supplementary illustrations are provided where necessary.

HALORAGIS

12. *Haloragis trigonocarpa* F. Muell.

A collection of this species by Royce (*Royce* 5921, 16.vii.1959, Dorre Island, PERTH (fl.)) from Shark Bay is the first record from an offshore island. Several collections from the nearby mainland were listed previously.

13. *Haloragis acutangula* F. Muell.

Recently collected material of *H. digyna* from near Esperance forms a link between that species and plants formerly (Orchard, 1975) described as *H. acutangula* f. *occidentalis*. It is still unclear whether all of the Western Australian plants listed under *H. acutangula* f. *occidentalis* (including the type) should be transferred to *H. digyna*, or whether some of them are best retained in *H. acutangula*. Further collections in flower and fruit are required from coastal areas between Albany and Eucla, to help decide this question. (See also under *H. digyna*).

14. *Haloragis aspera* Lindl.

In my previous paper two Western Australian collections (*Blackall* 1221, *Gardner* 2919) were referred to this species. Both collections were in flower only, and although differing from typical *H. aspera* in some respects, they were placed in this species until further material should become available. Four more collections have now been made from the Norseman-Widgiemooltha area, all bearing flowers and fruits, and all matching the two previous collections. Now that complete material is available it seems that these Western Australian plants differ from *H. aspera* in a number of characters, including leaf shape, size and shape of the secondary bracts of the inflorescence, and most

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noticeably, in fruit shape. They are therefore placed in a separate species, *H. dura*, distinct from, but closely related to, *H. aspera*. *H. aspera* s.str. is now considered to be absent from Western Australia.

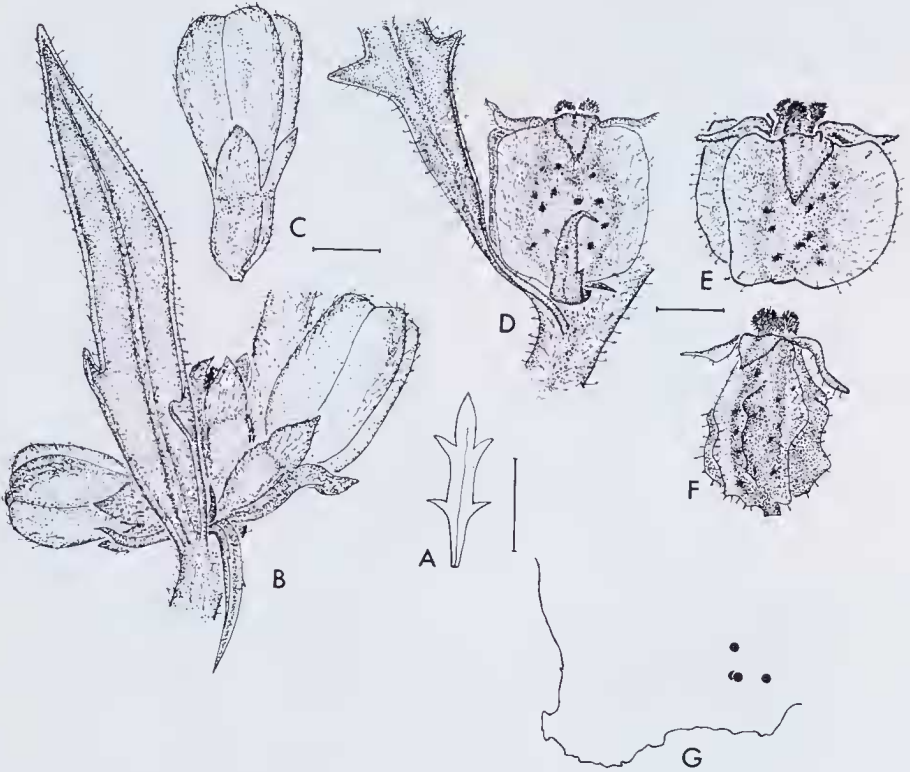


Figure 1—*Haloragis dura*. A. Leaf. B. Portion of inflorescence, showing primary, secondary and tertiary bracts. C. Flower just before anthesis. D. Portion of infructescence. E, F. Fruits. G. Distribution. (A,D,E. from Orchard 4186; B,C,F. from Orchard 4187). Scales represent 1 cm (A.) or 1 mm (B–F).

14a. *Haloragis dura* Orchard, sp. nov.

Figures 1, 2

Herba perennis 25–35 cm alta, caudex stoloniformis, caules erecti herbacei dense vestiti pilis simplicibus 2–3-cellularis pellucidis apice uncatis 0.2 mm longis. *Folia* alterna lanceolata vel oblanceolata vel subcuneata sessilia (1.2–)1.5–2.3 cm longa (0.3–)0.5–0.8 cm lata dentibus 4–6 falco-deltoidibus scabra.

Flores 4-merus, in spicis dichasiorum sessilium (1–)3-florum. *Bracteae primariae* foliaceae lanceolatae 0.7–1.0(–1.3) cm longae 0.2–0.4(–0.6) cm latae 2–4-dentatae scabrae. *Bracteae secundariae* membranaceae lineares 2.0–3.0(–4.0) mm longae 0.3–0.4 mm latae plerumque dentibus 2 parvis scabrae. *Bracteae tertiariae* membranaceae lineares 1.0–1.2 mm longae, 0.2 mm latae integrae scabrae. *Sepala* 4 ovata 1.0 mm longa 0.7 mm lata dense vestita pilis uncatis. *Petala* 4, 2.5–2.8 mm longa 0.6–0.7 mm lata scabra in carina. *Stamina* 8, antherae 1.8–2.0 mm longae. *Styli* 4. *Ovarium* ovoideum 0.8–1.0 mm longum, 0.5–0.8 mm latum, infirme 4-angulatum, dense scabrum, 4-locellatum, ovulum 1 per loculum.

Fructus oblongus 4-alatus, 2.5–3.0 mm longus 2.6–3.0 mm latus (alae inclusae), alae 0.5–1.0 mm latae raro ad costas deminutas, irregulariter foveatus et verrucosus inter alas; sepala persistentia patentia delata 1.3–1.4 mm longa 0.9–1.0 mm lata; loculi 4, semen 1 per loculum.

Holotypus: A. E. Orchard 4186, 23.xi.1974, Western Australia; ca 50 km south of Widgimooltha. On roadside at edge of bitumen, AK (fl., fr.). *Isotypi*: CANB, PERTH, AD, L, MO.



Figure 2—Holotype of *Haloragis dura*.

Perennial herb 25–35 cm tall; rootstock stoloniferous; stems erect, green, herbaceous, unribbed, densely clothed with simple 2–3-celled hyaline hairs 0.2 mm long hooked at tip. Leaves green to subglaucous, alternate, lanceolate to oblanceolate or subcuneate, (1.2–)1.5–2.3 cm long, (0.3–)0.5–0.8 cm wide,

scabrous on both surfaces with hooked hairs as for stems, serrate with 4-6 falcate-deltoid teeth 2-3 mm long; apex acute; margin revolute; midrib sunken above, prominent below; other veins indistinct.

Inflorescence an indeterminate spike of (1-)3-flowered dichasia borne in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. *Primary bracts* green, leaflike, lanceolate, 0.7-1.0(-1.3) cm long, 0.2-0.4(-0.6) cm wide, 2-4-dentate, midribbed, scabrous on both faces, with revolute margins. *Secondary bracts* (green-)straw-coloured, membranous, linear, 2.0-3.0(-4.0) mm long, 0.3-0.4 mm wide, usually with 2 small teeth, weakly midribbed, scabrous on outer face. *Tertiary bracts* straw-coloured, membranous, linear, 1.0-1.2 mm long, 0.2 mm wide, entire, scabrous.

Flowers 4-merous. ± sessile. *Sepals* 4, green, ovate, 1.0 mm long, 0.7 mm wide, densely scabrous with hooked hairs. *Petals* 4, red, 2.5-2.8 mm long, 0.6-0.7 mm wide (keel to margin), hooded, keeled, shortly unguiculate, scabrous. *Stamens* 8; filaments 0.2-0.3 mm long; anthers red to yellow, linear-oblong, 1.8-2.0 mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate. *Styles* 4, clavate; stigmas red, capitate, fimbriate. *Ovary* ovoid, 0.8-1.0 mm long, 0.5-0.8 mm wide, slightly 4-angled, densely scabrous, 4-locular, 1 ovule per locule.

Fruit reddish-green, usually solitary in axil of primary bract, on pedicel ca 1 mm long, oblong, 4-winged, 2.5-3.0 mm long, 2.6-3.0 mm wide (including wings); wings 0.5-1.0 mm wide, rarely reduced to ribs; fruit irregularly pitted and verrucose between wings, scabrous; sepals persistent, spreading, deltoid, 1.3-1.4 mm long, 0.9-1.0 mm wide; 4 locules, 1 seed per locule.

H. dura is confined to the Norseman-Widgiemooltha region of Western Australia, where it is found in red, sandy, often stony, soils. It is locally abundant on roadsides, particularly in the gutters at the edge of the road. The epithet "*dura*" refers to its harsh, dry texture, even when fresh. *H. dura* belongs to the *H. aspera*-*H. uncatipila* alliance, but can be distinguished from these species by a number of characters. The key in Orchard (1975) should be amended as follows:

18. Hairs hooked at tip, 2-4-celled, 0.1-0.5 mm long.
 22. Fruit ovoid, pyriform, globular or winged, exocarp not swollen or spongy.
 - 22a. Secondary bracts 1.2-1.4 mm long, entire; leaves usually more than 6-toothed; fruit ovoid, pyriform or globular, if ribbed, then ribs only in upper part of fruit; sepals in fruit erect. **14. *H. aspera***
 - 22a. Secondary bracts 2.0-3.0(-4.0) mm long, often 2-toothed; leaves less than 6-toothed; fruit usually 4-winged, or if wings reduced to ribs, then ribs run entire length of fruit; sepals in fruit spreading or reflexed. **14a. *H. dura***
 22. Fruit globular, exocarp swollen, spongy, sepals erect or reflexed in fruit. **15. *H. uncatipila***

From *H. hamata*, *H. dura* is easily distinguished by its relatively shorter, broader leaves and larger fruit with 4 oblong longitudinal wings and regularly 4-locular ovary, and from *H. acutangula*, *H. odontocarpa*, *H. foliosa*, *H. aculeolata* and *H. scoparia*, *H. dura* is distinguished by, *inter alia*, its hooked hairs.

Specimens examined: Blackall 1221, 30.x.1931, hills 7 miles [11 km] from Norseman, PERTH (fl.); Gardner 2919, 27.x.1931, Norseman, PERTH (fl.); Orchard 4176, 23.xi.1974, Fraser Range ca 115 km east of Norseman, AK, PERTH, CANB (fl., fr.); Orchard 4185, 23.xi.1974, 5.5 km west of Norseman, AK, PERTH, CANB (fr.); Orchard 4186, 4187, 23.xi.1974, ca 50 km south of Widgiemooltha, AK, CANB, PERTH (fl., fr.).

The specimen Orchard 4185 differs from the other fruiting collections in that in most of its fruits the wings are reduced to small ribs. However in other respects this specimen agrees with the description of *H. dura* given above.

17. *Haloragis foliosa* Benth.

Figure 3

Two further collections of this poorly known species have been made from the mid-west coast region of Western Australia. They are *Orchard* 4213, 27.xi.1974, 37 km south of Dongara on coast track just south of Cliff Head, AK, PERTH (fl.); *Orchard* 4219, 27.xi.1974, 56 km south of Dongara on coast track, AK, PERTH (fl., fr.). As these are the first collections of the species since Drummond's type gathering, and the first to bear mature fruits, an amended description of the species is given below.

Perennial herb or subshrub to 50 cm tall; stems woody at base, ascending, red to green, smooth or weakly 5-ribbed, sparsely scabrous with simple 2-4-celled, curved or slightly hooked hairs 0.2-0.4 mm long.

Leaves bright green, alternate, sessile, linear to linear-lanceolate, (1.5-) 3.0-4.5 cm long, 0.2-0.4(0.7) cm wide, ± entire or minutely serrate with 4-8 teeth ca 1 mm long, mainly in upper part, sparsely scabrous with hairs as for stems, apex acute: all veins indistinct.

Inflorescence an indeterminate spike of 1-3-flowered dichasia in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. *Primary bracts* broad-lanceolate, 0.9-1.4 cm long, (0.2-0.4) mm wide, green, fleshy, ± entire, midribbed, scabrous on margins; *secondary bracts* ovate, (1.7-2.5-3.5) mm long, (0.4-1.0-1.3) mm wide, green, fleshy, entire, strongly midribbed (almost keeled), glabrous but for a few scattered hairs on margins; *tertiary bracts* as for secondary, 2 mm long, tip attenuate.

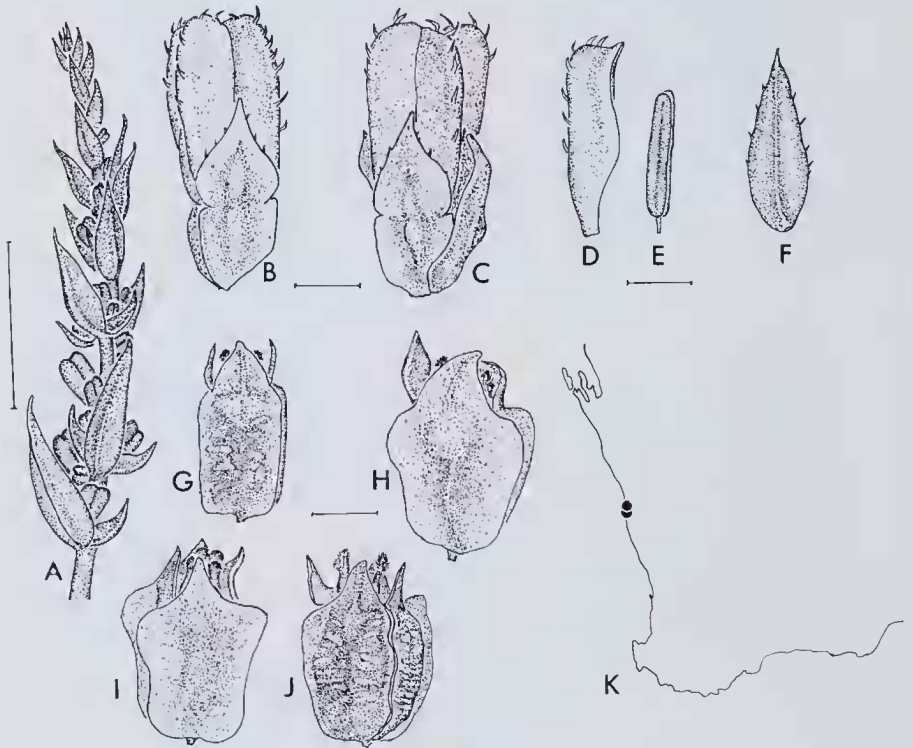


Figure 3—*Haloragis foliosa*. A. Upper part of inflorescence. B. Flower. C. Flower with secondary bract. D. Petal. E. Stamen. F. Secondary bract. G-J. Fruits. K. Distribution. (A-F. from Orchard 4213; G-J. from Orchard 4219.) Scales represent 1 cm (A.) or 1 mm (B-J.).

Flowers 4-merous, sessile. *Sepals* 4, ovate to subcordate, 1.3–1.9 mm long, 1.1–1.2 mm wide, weakly midribbed, otherwise smooth; tip very shortly acuminate; margin with a few curved hairs. *Petals* 4, hooded, keeled, very shortly unguiculate, 3.0–3.2 mm long, 0.9–1.3 mm wide (keel to margin), scabrous on keel. *Stamens* 8; filaments 0.1–0.3 mm long; anthers yellow, linear-oblong, 2.0–2.7 mm long, 0.3 mm wide, 4-locular, nonapiculate, anti-sepalous anthers ca 0.2 mm longer than antipetalous ones. *Styles* 4, clavate, 0.5–0.6 mm long; stigmas capitate. *Ovary* obpyramidal, 1.0–1.4 mm long, 0.8–1.0 mm wide, strongly 4-angled opposite petals, weakly ribbed opposite sepals, glabrous except for sparse hairs on ribs, 4-locular, with 1 pendulous ovule per locule.

Fruit oblong, 1.7–1.8 mm long, 1.2–1.3 mm wide (excluding wings), strongly 4-angled, with a narrow longitudinal wing on each angle, shallowly grooved opposite sepals, with faint horizontal ribs between grooves and wings, glabrous; wings 0.3 mm wide at top tapering to 0.1 mm at base; sepals persistent, erect, enclosing styles, deltoid, 0.8 mm long, 0.9 mm wide, faintly midribbed; 4-locules, 1 seed per locule.

Both of these new collections were rounded, multistemmed shrubs growing in shallow sand over limestone in low coastal heath. Both were in young flower in late November and one (*Orchard* 4219) still bore old fruits from the previous season. In their habit, habitat, leaf, flower and fruit morphology these plants very closely resemble *H. acutangula*, the fruits coming closest to *H. acutangula* f. *acutangula*. The main distinguishing characters between the two species are the sepals of the flowers (subcordate, 1.3–1.9 x 1.1–1.2 mm in *H. foliosa*; deltoid, 0.8–1.0 x 0.7–0.8 mm in *H. acutangula*), and the secondary bracts (fleshy and \pm keeled in *H. foliosa*; membranous and \perp lacking a midrib in *H. acutangula*). The hairs of the new collections are strongly curved in some parts, but lack the distinct sharply hooked tip of *H. aspera* and its allies.

The affinities of *H. foliosa* must now be considered to lie with *H. acutangula* rather than with *H. aspera* as suggested earlier. The relationship of *H. foliosa* to other members of this complex in Western Australia (*H. scoparia*, *H. aculeolata*) is still uncertain. Clarification must await further collections of all species involved.

20. *Haloragis hamata* Orchard.

Figure 4

Several more collections of this species have been made since its description, extending its known range northwards towards Norseman. The collections are *Orchard* 4436, 4438, 16.xii.1974, Near Young River ca 40 km directly north of the coast, AK, CANB. PERTH (fr.); *Orchard* 4439, 4440, 16.xii. 1974, Esperance-Norseman road ca 73 km south of Norseman, AK, CANB, PERTH (fl., fr.); *Orchard* 4442, 17.xii.1974, Esperance-Norseman road ca 50 km south of Norseman, AK, CANB. PERTH (fr.). The plants were locally abundant, particularly in roadside hollows and depressions, and seem to be confined to red sandy soils containing limestone nodules, always in inland localities. In these respects *H. hamata* differs from the superficially similar *H. digyna* which occurs nearby, but is so far recorded (in Western Australia) only from the deep white sand of coastal dunes (see below).

The fruits of these new collections differ slightly from those of previous gatherings. They are more or less depressed globose in shape, ca 1.4 mm long, 1.8 mm wide, with pronounced angles or thick rounded deltoid longitudinal wings alternating with the sepals, the sepals persistent, erect, deltoid, 0.9 mm long, 0.8 mm wide, smooth and glabrous. The body of the fruit between the

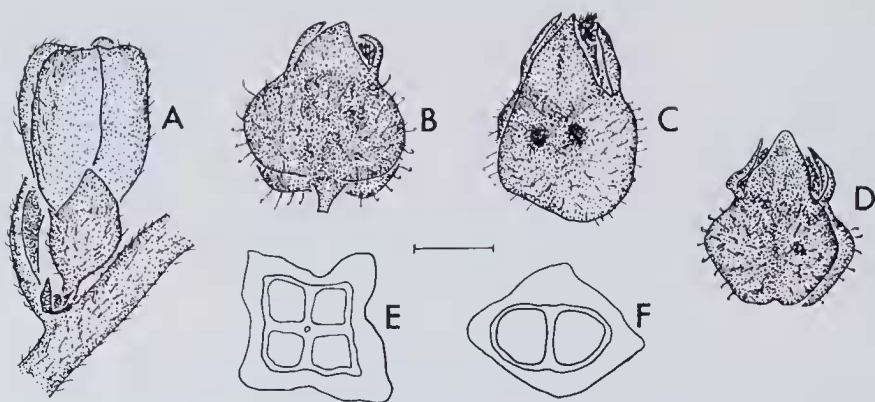


Figure 4—*Haloragis hamata*. A. Portion of inflorescence. B-D. Fruits. E. Transverse section of 4-locular fruit (fig. B). F. Transverse section of 2-locular fruit (fig. C). (A-C, E, F. from Orchard 4442; D. from Orchard 4438). Scale represents 1 mm (all figures).

angles or wings is weakly and irregularly verrucose, and the whole fruit, excluding the sepals, is densely scabrous with spreading hooked hairs. The fruit is 2-4-locular with a woody endocarp and septa, and a spongy exocarp.

24. *Haloragis digyna* Labill.

Figure 5

Two further collections of this species suggest that changes are necessary in the previous treatment of the species (Orchard, 1975). The collections (Orchard 4444, 4445, 18.xii.1974, 5 km east of Esperance, AK, CANB, PERTH (fl., fr.)) came from white coastal sand-dunes, where the plants are locally abundant. In general appearance the plants resemble *H. hamata* but differ in being more or less glabrous, with only very few scattered curved or \pm hooked hairs. However, the main difference between the species lies in their fruits. In *H. digyna* the fruits are glabrous, \pm cylindric, 1.8-2.0 mm long, 1.0 mm wide, with 4 distinct angles alternating with the sepals, produced into narrow acute deltoid wings near the base, and strongly verrucose on the faces between the ribs. The sepals are persistent, erect, \pm ovate, 1.3 mm long, 0.8 mm wide, enclosing the styles. The fruit is 1-2-locular, with a woody endocarp and septa, and closely appressed, non-spongy exocarp.

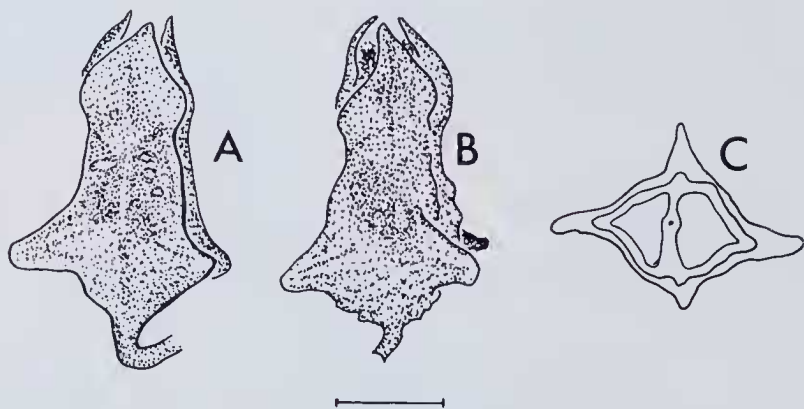


Figure 5—*Haloragis digyna*. A, B. Fruits. C. Transverse section of fruit. (all from Orchard 4445). Scale represents 1 mm.

Re-examination of the collections *Orchard* 1726 and 1728, formerly placed in *H. acutangula* f. *occidentalis*, has revealed that they are also *H. digyna*, and this casts doubt on the other Western Australian collections of *H. acutangula* f. *occidentalis*. Some of these, at least, have a fruit which differs from that described above, in that it is 4-locular, with definite deltoid wings occupying the entire length of the fruit. Whether these collections should also be referred to *H. digyna* is a question which must be deferred until a more representative series of collections can be assembled from the entire southern coast of Western Australia. The specimens from South Australia cited under *H. acutangula* f. *occidentalis* definitely belong in *H. acutangula*, and will require a new name if the Western Australian members of this forma (including the type) are transferred to *H. digyna*.

The South Australian collections previously included in *H. digyna* (Orchard, 1975) differ from these new collections principally in habit, the South Australian plants being weak and herbaceous while the Esperancee plants are erect and distinctly woody at the base. Further collections from Eyre Peninsula would be useful to help decide whether or not this difference is significant.

Haloragis pedicellata Schindler and **H. viridis** Schindler

These two species were inadvertently omitted from my previous treatment. Both were based on type specimens formerly in B, but subsequently lost. No duplicates of the types have been located, nor have any other collections ever been assigned to either of these species.

The first species, *H. pedicellata*, as described by Schindler differed from *H. exalata* mainly in its pedicellate flowers, and its serrate calyx lobes which lacked a median basal callus. The difference in length of flower pedicel is no longer a useful character now that more material of *H. exalata* is available, nor is the lack of a basal callus on the sepals. The remaining difference, the two teeth near the tips of the sepals in *H. pedicellata*, compared with the entire lobes in *H. exalata*, scarcely seems sufficient to keep the two species distinct. Pending the discovery of further material, it is probably best to include *H. pedicellata* in the synonymy of *H. exalata*.

Haloragis viridis does not seem (*ex descr.*) to differ in any significant manner from *H. stricta* R.Br. ex Benth., and is here included in this species.

HALORAGODENDRON

5. Haloragodendron glandulosum Orchard

A further collection of this species from between Ravensthorpe and Southern Cross (*Newbey* 3469, 6.i.1971, Hatter's Hill, PERTH (fr.)) suggests that the plant may eventually prove to be widely distributed throughout the area approximately defined by the square Kalgoorlie-Southern Cross-Hopetoun-Esperancee. This latest collection is described as "2 ft [60 cm] high in loam, dominant in some areas burnt 2 years ago".

GONOCARPUS

7. Gonocarpus sanguineus (Merr. & Perry) Orchard

The collection *Armit* s.n., 1894, Mt. Dayman, MEL (fr.), not previously listed, represents the first known record of this plant, predating the next known collection (*Clemens* 102477) by 45 years.

8. *Gonocarpus halconensis* (Merr.) Orchard

The collection *MacGregor* s.n., 1894, lower ranges of British New Guinea, MEL (fl.), not previously listed, is the first known record of this plant. It predates the earliest Merrill collection from the Philippines (*Merrill* 5700), the type of *H. halconensis*, by 12 years.

13. *Gonocarpus implexus* Orchard

A further collection has been made of this species from the Kimberley region of Western Australia. The collection (*George* 12415, 19.viii.1974, Blyxa Creek, Prince Regent River Reserve, PERTH) was made in open woodland near the creek in sandy loam. It was cited by *George & Kenneally* (1975) as "*Haloragis* sp."

14. *Gonocarpus chinensis* (Lour.) Orchard subsp. *chinensis*

Another collection of this species has been made from the Kimberley region of Western Australia. The collection (*George* 12541, 22.viii.1974, Blyxa Creek, Prince Regent River Reserve, PERTH) was a straggling perennial herb growing in damp sand among open woodland of *Melaleuca viridiflora* and *Eucalyptus houseana*. It was cited by *George & Kenneally* (1975) as *Haloragis chinensis* (Lour.) Merrill, and noted as a new record for Western Australia. *Fitzgerald* had collected the same plant from three other localities in the Kimberleys in 1905, but the collections had not been identified as *G. chinensis* until my previous work.

20. *Gonocarpus leptothecus* (F. Muell.) Orchard

Figure 6

A number of new collections of this species from Western Australia and the Northern Territory have increased the known east-west range of the plant. In most cases, the collector's notes accompanying the specimens indicate that they were growing in sandstone soils, as was the case with most previous collections. The new collections are:

WESTERN AUSTRALIA: *George* 12450, 19.viii.1974, Blyxa Creek, Prince Regent River Reserve, PERTH; *Wilson* s.n., 27.v.1972, Champagne Island, Bonaparte Archipelago, PERTH (fr.); *Wilson* 10655, 12.v.1972, Augustus Island, Bonaparte Archipelago, PERTH (fr.); *Wilson* 10906, 22.v.1972, Heywood Island (south), Bonaparte Archipelago, PERTH (fr.); *Wilson* 11412, 7.vii.1973, Boongaree Island, Prince Frederick Harbour, PERTH (fl., fr.). NORTH-TERRITORY: *Kanis & Schodde* 1822, 12.vi.1974, Upper Nicholson River area, China Wall, base camp on Fish River Gorge, CANB, AD (fr.).



Figure 6—Distribution of *Gonocarpus leptothecus*.

21. *Gonocarpus benthamii* Orchard

Figure 7

In my previous treatment of this species the few specimens cited seemed to indicate that *G. benthamii* was a relatively rare plant, sporadic in its occurrence in south-western Western Australia. On the contrary, recent collections and observations show that it is plentiful in the understorey of Karri, Jarrah and Marri forests throughout the region south of Perth, and in some places where forestry management has eliminated most of the shrubby species, *G. benthamii* forms almost the entire understorey.

The new collections are:

Orchard 4323, 7.xii.1974, Big Brook, Bussell Highway, 5 km north of Margaret River township, AK, CANB, PERTH (fl.); *Orchard* 4332, 7.xii.1974, Margaret River at The Rapids, AK (fl.); *Orchard* 4339, 8.xii.1974, ca 8 km south-west of Alexandra Bridge on Kudardup Road, AK, CANB, PERTH (fl., fr.); *Orchard* 4361, 10.xii.1974, 15 km south-west of Pemberton on Yeagarup Road, AK, CANB, PERTH (fl.); *Orchard* 4363, 10.xii.1974, 7 km west of Shannon at corner of Middleton Road and Deeside Coast Road, AK, CANB, PERTH (fl.); *Orchard* 4368, 10.xii.1974, Shannon River at Lower Shannon Road crossing, AK, CANB, PERTH (fl.).



Figure 7—Distribution of *Gonocarpus benthamii*.

23. *Gonocarpus diffusus* (Diels) Orchard

Figure 8

Five further collections of this species have been made, significantly extending its known range. The collections are:

Orchard 4290, 4.xii.1974, 14 km by road from Dwellingup along North East Road, near the north-west corner of South Dandalup Dam, AK (fl., fr.); *Orchard* 4294, 5.xii.1974, north-east corner of Logue Brook Dam, AK (fl.); *Orchard* 4327, 7.xii.1974, Margaret River, along Canbrake Road, ca 18 km directly east-north-east of Margaret River township, AK (fl.); *Orchard* 4330, 7.xii.1974, Margaret River at The Rapids, AK (fl.); *Orchard* 4375, 11.xii.1974, 50 km north of Walpole on the Mt. Frankland road, AK, CANB (fl., fr.).

All of these plants were prostrate, very local in distribution, and always in close proximity to water. In fact, several were collected half submerged in shallow water, suggesting that intermittent flooding may be one of the ecological



Figure 8—Distribution of *Gonocarpus diffusus*.

requirements of the species. Where this species occurs with *G. benthamii* (e.g. Orchard 4330, 4332), *G. diffusus* is found in the wetter areas. There are a number of minor differences between these recent collections and the description given previously. The stems are closely appressed pubescent, with unicellular hairs, particularly in the upper parts, becoming more or less glabrous towards the base. The leaves are moderately densely pilose on both faces, with hairs as for the stems. Many of the flower petals and anthers are much shorter than previously reported. The petals of apparently fully bisexual flowers can be as short as 0.8 mm, with anthers 0.4–0.5 mm long. The ovaries and fruits of these plants have, without exception, several short, thick, strongly curved hairs or papillae on the ribs, a feature previously (Orchard, 1975) described as “anomalous”. The discovery of these plants, and their differences from previous collections, casts doubts on whether *G. diffusus* and *G. intricatus* are really distinct. The only remaining differences between the species are the shape of the sepals (cordate in *G. intricatus*, deltoid-ovate and saccate in *G. diffusus*) and a slight difference in the size of the fruits. If the two species are merged in future, then the epithet “*intricatus*” has priority.

24. *Gonocarpus rudis* (Benth.) Orchard

A further collection of this species has been made, providing further information on the habit and habitat requirements of *G. rudis*. The collection (Orchard 4415, 14.xii.1975, Stirling Range National Park, 2 km from Red Gum Pass road along Stirling Range Drive, AK, CANB, PERTH (fr.)) was a round subshrub, locally abundant, to 30 cm tall, softly reddish pubescent, growing in deep red sand on the roadside. Previous collections had given the impression that the plant was single-stemmed, with a “trunk” 5–10 cm tall arising from a fibrous rootstock, with numerous herbaceous branches borne near its apex. In fact, all plants in the population studied were multistemmed subshrubs, and the “trunks”, 20–30 in number, were only the primary branches, bearing

adventitious roots in their lower parts. Previous collections have shown considerable variation in fruit morphology. The fruits of *Orchard* 4415 are blackish purple, ovoid to globular, 0.8–0.9 mm long, 0.8–0.9 mm in diameter, 8-ribbed longitudinally, sparsely appressed pilose at the base and on the ribs; the sepals are persistent, erect, greenish-red, deltoid, 0.6–0.7 mm long, 0.5–0.6 mm wide, with a prominent median basal callus, and glabrous.

26. *Gonocarpus pusillus* (R.Br. ex Benth.) Orchard

Figure 9

This species was one of the most poorly known when the previous treatment of the genus went to press. It was known only from the type, of which I had seen only a fragmentary isotype from MEL. Two further collections which appear to belong here are now known, and are the basis for the amended description which appears below.

Prostrate annual *herbs* to 5 cm tall; *stems* to 10 cm long, spreading from central taproot, green, weakly 4-ribbed, glabrous. *Leaves* opposite at base, becoming alternate, linear to linear-lanceolate, 0.7–0.8 cm long, 0.1 cm wide, coriaceous, no veins apparent, glabrous.

Inflorescence an indeterminate spike of flowers borne singly in the axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. *Primary bracts* leaflike, lanceolate to ovate, (1.7–)2.0–2.5 mm long, 0.5–0.7 mm wide, coriaceous, glabrous. *Secondary bracts* green, fleshy to membranous, lanceolate, 0.5–1.2 mm long, 0.2–0.3 mm wide, often deciduous, glabrous or sparsely scabrous near tip with hairs 0.1 mm long.

Flowers 4-merous, on pedicels 0.1–0.2 mm long. *Sepals* 4, deltoid, 0.3 mm long, 0.3 mm wide, subsaccate at base, glabrous, margin thickened. *Petals* 4, yellow to reddish, hooded, keeled, unguiculate, 0.9–1.0 mm long, 0.3 mm wide (keel to margin), scabrous on keel with simple white unicellular hairs 0.1 mm long. *Stamens* 8; filaments 0.2 mm long; anthers red, oblong, 0.5–0.6 mm long, 0.2 mm wide, 4-locular, nonapiculate. *Styles* 4, clavate; stigmas red, fimbriate. *Ovary* silver-grey, ovoid to globular, 0.6–0.7 mm long, 0.6–0.7 mm wide, 8-ribbed, scabrous particularly on ribs and in lower part, with white unicellular appressed hairs; septa \pm absent; ovules 4 pendulous.

Fruit on pedicel 0.2–0.3 mm long, grey, ovoid to globular, 0.8 mm long, 0.8 mm wide, 8-ribbed, scabrous towards base and on ribs; sepals persistent, erect, green to purplish, deltoid, 0.3–0.4 mm long, 0.3–0.4 mm wide, glabrous, enclosing styles; 1 seed.

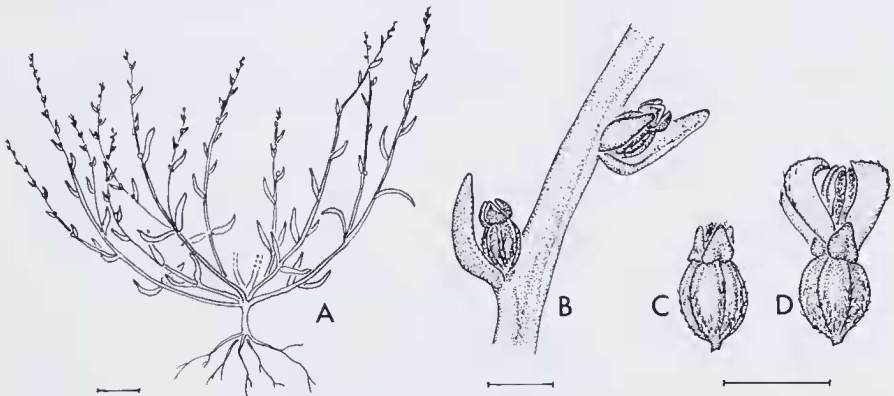


Figure 9—*Gonocarpus pusillus*. A. Habit. B. Flower. C. Portion of infructescence. D. Fruit. (All from Orchard 4371). Scales represent 1 cm (A.) or 1 mm (B-D.).

These collections (*Orchard* 4344, 8.xii.1974, Long Swamp ca 10 km directly north-east of Augusta, AK, CANB, PERTH (fl., fr.); *Orchard* 4371, 11.xii.1974, ca 3 km north of Mt. Frankland turnoff on Walpole-Mt. Frankland road, AK, CANB, PERTH (fl., fr.)) were found in low-lying restionaceous heath areas, probably subject to intermittent flooding in winter. The plants were inconspicuous but relatively abundant in these areas, growing in blackish sand, with Restionaceae, Epacridaceae, *Drosera* spp., *Thysanotus* spp. and *Gonocarpus paniculatus*. The two species of *Gonocarpus* are easily distinguished in the field. *G. pusillus* is prostrate with a relatively short, thick, green axis to the inflorescence, unbranched but for a few simple lateral inflorescences. *G. paniculatus* is a stiff, erect plant with profusely branched filiform reddish inflorescences. The leaves and flowers of *G. paniculatus* are also much larger than those of *G. pusillus*.

27. *Gonocarpus eremophilus* Orchard

One further collection of this species is now known: *George* 12175, 27.vii.1974, 53 miles [85 km] south-west of Warburton, Gibson Desert, PERTH (fl.). Like the earlier collections it was found on an open gravelly plain, associated with *Triodia basedowii*.

30. *Gonocarpus pithyoides* Nees

The three collections below considerably extend the known range of this species northwards:

Orchard 4258, 29.xi.1974, Gingin-Dongara road ca 4 km south of Mullering Brook, AK, CANB, PERTH (fl., fr.); *Orchard* 4259, 29.xi.1974, 6 km south of Dandaring West, AK, CANB, PERTH (fl., fr.); *Orchard* 4273, 1.xii.1974, 12 km west of Gingin-Dongara road along Moore River, AK, CANB, PERTH (fl., fr.).

31. *Gonocarpus simplex* (R.Br. ex Britten) Orchard

This species was previously known only from the type and a collection by C. P. Andrews, both from near Albany, and both lacking fruits. Even in this incomplete state it was clear that *G. simplex*, with its \pm leafless, sedge-like stems and small flowers was an unusual member of the genus *Gonocarpus*. Two further collections of this species (*Orchard* 4443, 4443a, 17.xii.1974, access road to Cape Le Grand, ca 5 km north of National Park boundary, AK, CANB, PERTH (fl., fr.)) bearing a range of flowers and fruits, and one of them (*Orchard* 4443a) consisting of seedlings, have revealed that *G. simplex* differs from other *Gonocarpus* species in a number of other respects, and it is proposed that *G. simplex* should be segregated from the rest of the genus in a new section, *Gonocarpus* sect. *Simplum*, defined as follows.

Gonocarpus section *Simplum* Orchard, sect. nov.

Styli subulati, sepala magnopere excedens; flores masculi in pedicellis longis elevatis; fructus lineares, longitudo ultra bis diametrum. Typus: *Gonocarpus simplex* (R.Br. ex Britten) Orchard.

The plants of this new section differ from those of *Gonocarpus* sect. *Gonocarpus* mainly in having long subulate styles greatly exceeding the sepals, in having male and bisexual flowers, probably on separate plants, with the male flowers borne on long pedicels, the bisexual flowers \pm sessile, and in having linear or cylindrical fruits more than twice as long as their diameter.

Key to the sections of genus *Gonocarpus*

Styles clavate, not, or barely exceeding sepals; flowers all bisexual (or, rarely, functionally female), all \pm sessile; fruit ovoid, globular or shortly cylindrical, length (excluding sepals) less than twice diameter..... sect. *Gonocarpus*
 Styles subulate, greatly exceeding sepals; bisexual flowers \pm sessile, male flowers on long pedicels; fruit linear, length (excluding sepals) more than twice diameter..... sect. *Simplum*

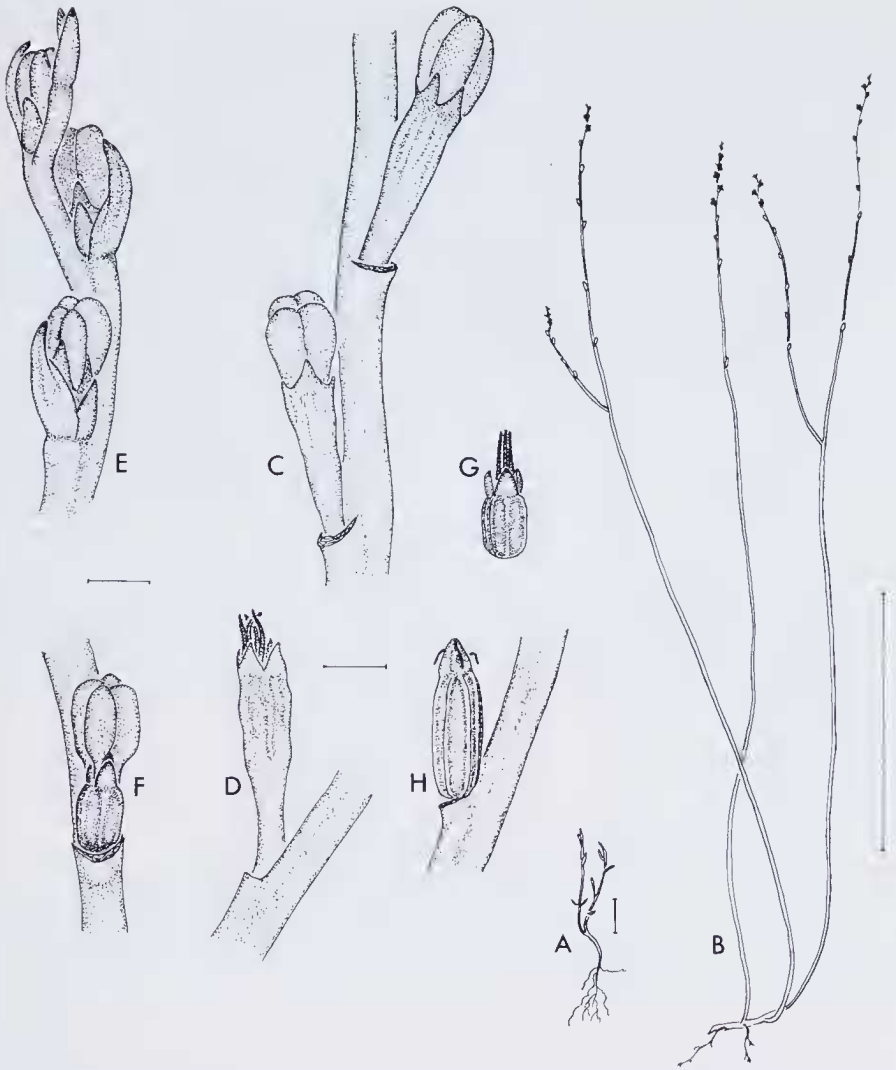


Figure 10—*Gonocarpus simplex*. A. Seedling. B. Habit of mature plant. C. Portion of male inflorescence, with primary bracts already shed. D. Male flower after shedding of petals and stamens. E. Tip of inflorescence showing bisexual flowers in axils of primary and secondary bracts. F. Bisexual flower. G. Bisexual flower after shedding of petals and stamens. H. Fruit. (A. from Orchard 4443a; B-H. from Orchard 4443). Scales represent 1 cm (A.), 10 cm (B.) and 1 mm (C-H.).

An amended description of *G. simplex* based on the two new collections is given below.

Perennial herb to 40 cm tall; rootstock stoloniferous; stems green, herbaceous, ± leafless, sparsely branched, unribbed, glabrous. *Leaves* deciduous, alternate, linear, 0.5–1.0 cm long, 1 mm wide, glabrous; veins obscure apart from slight channelling above; tip with dark cap-like apiculum.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Occasional lateral inflorescences are borne in the axils of the upper bracts. *Primary bracts* red, membranous, deltoid, 1.7 mm

long, 0.3 mm wide (keel to margin), conduplicately folded and stem-clasping, with well defined keel, glabrous, deciduous before anthesis. *Secondary bracts* linear, 0.8–1.1 mm long, 0.2 mm wide, glabrous, deciduous.

Flowers 4-merous; male or bisexual, apparently on distinct plants. *Bisexual flowers* sessile; *sepals* 4, deltoid, 0.4 mm long, 0.3 mm wide, glabrous. *Petals* 4, hooded, \pm keeled, 1.7 mm long, 0.3 mm wide, long-unguiculate (ca $\frac{1}{4}$ of length), glabrous. *Stamens* 8; filaments 0.4 mm long; anthers linear-oblong, 0.9–1.0 mm long, 0.2 mm wide, 4-celled, nonapiculate. *Styles* 4, subulate, 0.8 mm long; stigmas fimbriate. *Ovary* linear-ovoid, 1.0 mm long, 0.4 mm diam., 8-ribbed, glabrous, incompletely 4-locular, 4 ovules. *Male flowers* as for bisexual ones, but on pedicel 2 mm long; ovary rudimentary.

Fruit green, sessile, linear-cylindrical, 1.8–1.9 mm long (excluding sepals), 0.6–0.7 mm wide, 8-ribbed, smooth between ribs, glabrous; sepals persistent, erect, deltoid, 0.4–0.5 mm long, 0.3–0.4 mm wide, smooth; styles protruding; 1 seed.

Seedlings with flexuose stems, first 2 leaves opposite, others alternate; stems and leaves bright green with reddish tips.

These two collections came from the margins of a small swamp, densely overgrown with Restionaceae, Cyperaceae and *Xyris*. The only associated trees were a few paperbark *Melaleuca* sp. The plants were relatively abundant, but inconspicuous, overtopped by sedges at the water's edge, particularly in disturbed places where the road crossed the swamp. The seedlings were numerous on a patch of black organic sand recently scraped clear of other vegetation. The swamp was some distance outside the boundary of Cape le Grand National Park, and a search of similar swamps inside the park failed to reveal *G. simplex*.

33. *Gonocarpus confertifolius* (F. Muell.) Orchard

A number of further collections of this species extend its known range.

G. confertifolius var. *confertifolius*: *Boswell* R29, 1967, Cundelee, PERTH (fr.); *Orchard* 4196, 26.xi.1974, Kalbarri National Park, 9 km south-east of turnoff to The Loop, on main access road, AK, CANB, PERTH (fl., fr.).

G. confertifolius var. *helmsii* Orch.: *Butler* s.n., 26.i.1958, Queen Victoria Springs, PERTH (fl., fr.); *Diels* s.n., Menzies, PERTH (fl.); *George* 7987, 12.ix.1966, 19 miles [30 km] W. of Sandstone, PERTH (fl.); *Orchard* 4188, 24.xi.1974, 18 km west of Coolgardie on road to Southern Cross, AK, CANB, PERTH (fl., fr.); *Orchard* 4191, 24.xi.1974, 45 km west of Coolgardie on road to Southern Cross, AK, CANB, PERTH (fl., fr.); *Orchard* 4193, 24.xi.1974, 95 km west of Coolgardie, AK, CANB, PERTH (fl., fr.); *Orchard* 4195, 24.xi.1974, Merredin-Goomalling road, ca 2.5 km east of Trayning, AK, CANB, PERTH (fl., fr.).

The Orchard collection of var. *confertifolius* has leaves 1.0 cm long and 0.4–0.5 cm wide, with 6–8 teeth. These dimensions are considerably larger than those given previously.

G. confertifolius var. *helmsii*, of which only a few collections were known previously, is much more common than suspected. It is abundant in the area between Coolgardie and Southern Cross, particularly along the sides of the main road, in the shallow gutters.

35. *Gonocarpus paniculatus* (R.Br. ex Benth.) Orchard

Figure 11

Previous records of this species seem to indicate that it was fairly rare. Only a handful of collections were known, and very few of these were recent. However, it is now apparent that the species is in fact relatively common in the south-west of Western Australia, particularly in the coastal region between Margaret

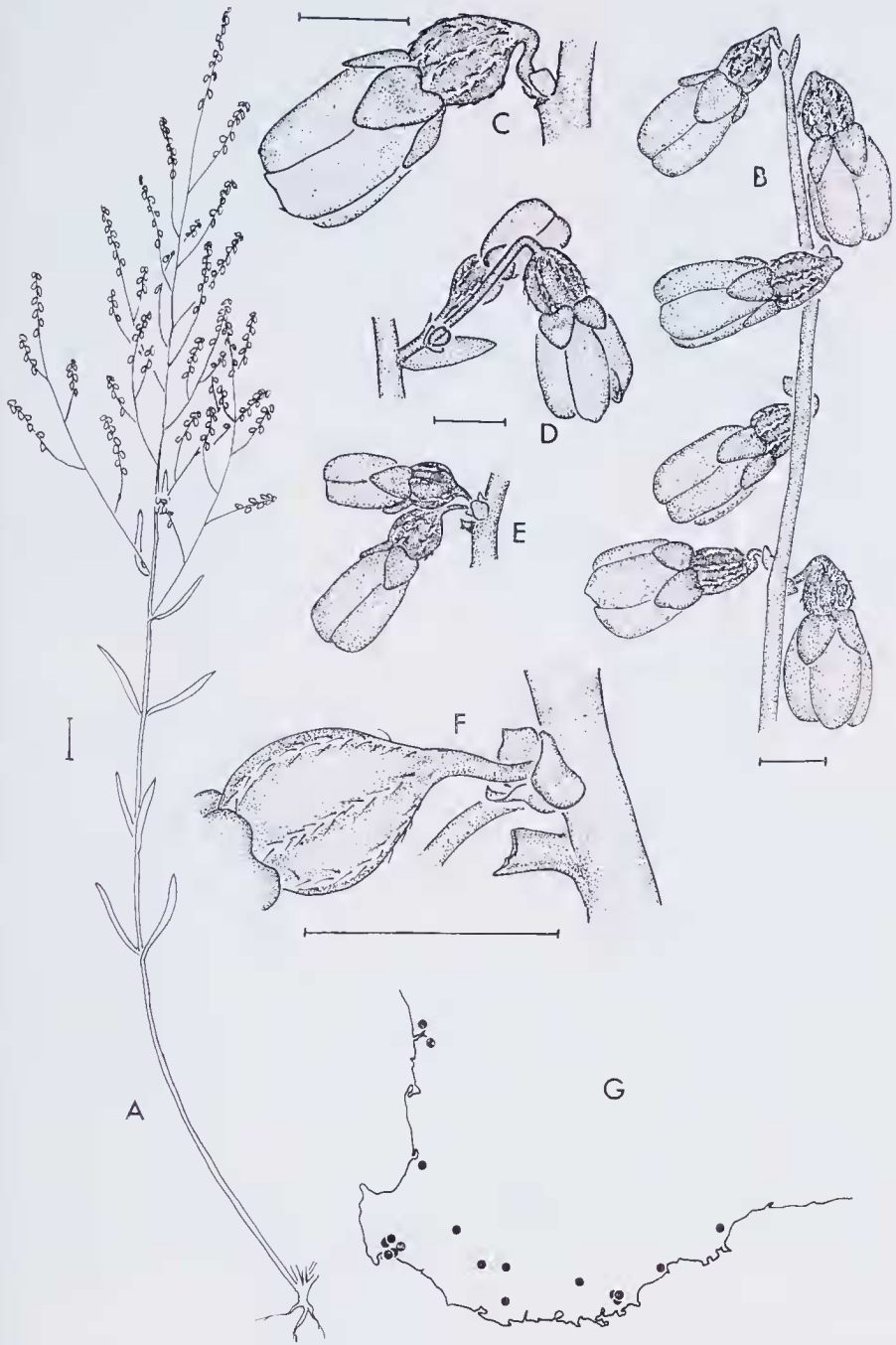


Figure 11—*Gonocarpus paniculatus*. A. Habit. B. Portion of inflorescence. C. Flower and secondary bracts. D-E. Flowers in fascicles of 3 and 2. F. As in E., but enlarged to show secondary and tertiary bracts. G. Distribution. (A-C. from Orchard 4422; D-F. from Orchard 4397). Scales represent 1 cm (A.), or 1 mm (B-F.).

River and Albany. It is found in lowlying areas, probably swampy in winter, usually on grey or blackish organic sands. In this type of habitat, *G. paniculatus* is usually abundant, but because of its delicate habit and dark coloration it is easily overlooked. The collections cited below considerably increase the known range of the species.

Newbey 2394, 16.i.1966, 5 miles [8 km] NW. Cape Riche, PERTH (fl., fr.); *Orchard* 4340, 8.xii.1974, Long Swamp ca 10 km directly NE. of Augusta, AK, CANB, PERTH (fl.); *Orchard* 4345, 8.xii.1974, Scott River Road, ca 9 km SE. of Alexandra Bridge, AK, CANB, PERTH (fl.); *Orchard* 4346, 9.xii.1974, ca 25 km E. of Augusta on Canebrake Road 1 km N. of Scott River, AK, CANB, PERTH (fl.); *Orchard* 4349, 9.xii.1974, 30 km E. of Alexandra Bridge at corner of Canebrake Road and Stewart Road, AK, CANB, PERTH (fl.); *Orchard* 4373, 11.xii.1974, ca 3 km north of Mt. Frankland turnoff on Walpole-Mt. Frankland road, AK, CANB, PERTH (fl.); *Orchard* 4384, 11.xii.1974, 6 km south of Tonebridge, AK, CANB, PERTH (fl.); *Orchard* 4386, 11.xii.1974, 2 km north of Lake Unicum, AK, CANB, PERTH (fl.); *Orchard* 4394, 12.xii.1974, 9 km south of Mt. Barker on Albany Highway, AK, CANB, PERTH (fl.); *Orchard* 4397, 13.xii.1974, Palmdale Road ca 8 km west of Manypeak, AK, CANB, PERTH (fl.); *Orchard* 4398, 13.xii.1974, Lake Corinup north of Manypeak, AK (fl., fr.); *Orchard* 4399, 13.xii.1974, Lake Warburton Road ca 12 km north of Manypeak, AK, CANB, PERTH (fl., fr.); *Orchard* 4422, 15.xii.1974, Fitzgerald River National Park ca 12 km north of Qualup Homestead, AK, CANB, PERTH (fl.).

These collections also show that *G. paniculatus* is more variable than previously thought. The leaves range from terete to distinctly flattened and linear and the fruits vary in shape from ovoid to turbinate (occasionally depressed globose) and from densely pilose on the ribs to completely glabrous. All, however, comply with the key characters described earlier (Orchard, 1975). *G. paniculatus* is closely allied to *G. pusillus*, with which it is sometimes found in the field. See under the latter species for distinguishing characteristics.

36. *Gonocarpus hexandrus* (F. Muell.) Orchard

This anomalous and variable species had not been collected for over 50 years when my previous treatment went to press. Further collections have now been made, and it seems that the plant is not as rare as previously thought, at least so far as the subspecies *serratus* and *integrifolius* are concerned. Both are weak, multistemmed shrubs to 1 m tall, found invariably on the banks of streams, usually in reddish sandy clay. All were sterile or only in very young bud in December. Leaf shape and size was very variable, casting doubt on the validity of keeping these two subspecies distinct. The plants grouped under subspecies *integrifolius* have leaves varying from broadly lanceolate (3.0 x 1.0 cm) to linear (2.0 x 0.3 cm) and \pm entire to 4-5-serrate, the teeth being fine, almost hair-like, and up to ca 0.5 mm long. The four plants included in subspecies *serrata* have generally broader leaves, ovate, the lower ones 2.5-5.0 cm long, 1.0-1.2 cm wide, coarsely 6-8-serrate with distinctly deltoid teeth 2-3 mm long. While the plants of subsp. *integrifolius* were always glabrous (except for a few soft hairs on the new growth), the plants of one population of subsp. *serratus* were either glabrous (*Orchard* 4352) or scabrous (*Orchard* 4351). In this case the glabrous plants were in young bud, while the scabrous plants were all sterile (early December).

Haloragis lanceolata R.Br. ex Benth., tentatively placed in the synonymy of *G. hexandrus* subsp. *hexandrus* in my previous paper, may be better included in *G. pusillus*, as the description quite closely matches the new collections of the latter.

The new collections of *G. hexandrus* are as follows.

G. hexandrus subsp. *serratus* (Schindler) Orchard

Orchard 4350, 9.xii.1974, Barlee Brook at Barlee Road crossing, 25 km S. of Nannup, AK, CANB, PERTH (fl.); *Orchard* 4351, 4352, 9.xii.1974, Barlee Brook at Dickson (Tower) Road crossing, AK, CANB, PERTH (fl.); *Orchard* 4360, 10.xii.1974, 15 km south-west of Pemberton on Yeagarup Road, AK, CANB, PERTH (fl.).

G. hexandrus subsp. *integrifolius* (Schindler) Orchard

Orchard 4321, 4324, 7.xii.1974, Big Brook, Bussell Highway, 5 km north of Margaret River township, AK, CANB, PERTH (fl.); *Orchard* 4329, 7.xii.1974, Margaret River at The Rapids, AK, CANB, PERTH (st.); *Orchard* 4356, 10.xii.1974, ca 20 km SW. of Pemberton at Neanup Swamp, AK, CANB, PERTH (st.); *Orchard* 4389, 12.xii.1974, Amarillup Swamp, ca 25 km NNW. of Denmark, AK, CANB, PERTH (fl.).

Acknowledgements

The Curators of the Western Australian Herbarium (PERTH) and Herbarium Australiense (CANB) kindly provided facilities for examining their collections. The patience of Mr Roy Pullen, who endured numerous detours in search of elusive Haloragaceae during a collecting trip in Western Australia in 1974, is much appreciated.

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References

- GEORGE, A. S., and K. F. KENNEALLY (1974). Flora, in J. M. Miles and A. A. Burbidge (ed.), A biological survey of the Prince Regent River Reserve, North-West Kimberley, Western Australia. Wildlife Research Bulletin 3. W. Aust. Dept. Fisheries & Wildlife.
- ORCHARD, A. E. (1975). Taxonomic revisions in the family Haloragaceae. I. The genera *Haloragis*, *Haloragodendron*, *Glischrocaryon*, *Meziella* and *Gonocarpus*. Bull. Auckland Inst. Mus. 10: 1-299.

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